Appendix D

North Bend Gravel Operation
Noise Technical Report

Noise Technical Report

For the North Bend Gravel Operation

Produced for URS Corp.
Seattle, WA.

By

Environalysis
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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Cadman, Inc. is proposing to develop a sand and gravel resource of approximately 690 acres in size located on two separate sites just east of North Bend, Washington. Operations at this site will include the mining, conveying, screening, crushing, washing and stockpiling of sand and gravel. Onsite processing will include the production of aggregate products, asphalt and concrete. The project consists of two sites: the Lower Site and Upper Site. The Lower Site is 115 acres (40 acres to be disturbed) surrounded on the west and east by commercial forestry land, on the south by I-90 and on the north by private property zoned rural-residential. The nearest residential property line is about 1,315 feet north of the center of the processing area; the closest residence is 1,780 feet away. The Upper Site is 578 acres (260 acres to be disturbed) surrounded on all sides by commercial forestry property with the closest residence nearly a mile away.

This document is an analysis of the existing noise levels in the project vicinity and the impacts the Proposal and its alternatives may have upon future noise levels. The analysis will examine the potential impacts created by the proposed project, using computer-modeling projections. This technical report will analyze the following design options:

- Alternative 1 – No Action- Commercial forestry activities would continue on the site.
- Alternative 2 – Proposal. This alternative includes mining on both sites, starting with the Lower Site. There would be primary crushing on Upper Site (Monday through Friday 7 a.m. to 5 p.m.) and asphalt, concrete and aggregate processing on Lower Site (Monday through Saturday 5 a.m. to 10 p.m.).
- Alternative 2 – Lower Site Option. This option reduces the size of the Lower Site processing area and relocates the outboard end of the Grouse Ridge conveyor belt, the surge pile, and the aggregate storage areas toward the southeast.
- Alternative 3 – Lower and Upper Site. Under this alternative there will be mining and asphalt and concrete production on the Lower Site (Monday through Saturday 5 a.m. to 10 p.m.) and mining and aggregate processing on Upper Site, after the Lower Site is mined out. (Monday through Friday 7 a.m. to 5 p.m.).
- Alternative 3 – Lower Site Option. This option reduces the size of the Lower Site processing area, relocates the outboard end of the Grouse Ridge conveyor belt, the surge pile, and the aggregate storage areas toward the southeast.
- Alternative 4 – Upper Site Only. Under this alternative the Lower Site would not be developed. Extraction and aggregate processing (only) would occur at the Upper Site (Monday through Friday 7 a.m. to 5 p.m., maintenance only on Saturdays).

1.2 METHODOLOGY

The analysis of noise impacts from the North Bend Gravel Operations Project involved two distinct phases: (1) the monitoring of existing background noise levels; and (2) the computer modeling of future

project-generated levels. Three Larson-Davis model 812 integrating Type 1 sound level meters and one Larson-Davis model 814 integrating Type 1 sound level meter were used to measure existing noise levels. Measurements of 24-hour duration were taken at seven locations most likely to be affected by project-generated noise. Measurements were made on two consecutive days with one site monitored on both days to serve as a point of comparison. Winds were generally southerly and light. There were periods of light rain during the two days of monitoring. . Additional short-term noise measurements were taken during windy periods to determine the effect that winds have on background noise levels. Winds of 15-20 mph appear to add 7-9 dBA to background dBA_{LEQ} noise levels. The calibration of the meter was checked before and after each reading with an acoustic calibrator, itself calibrated to a known source.

The modeling of future project-generated noise levels involved collecting noise samples of mining machinery from several operating mines and facilities including Cadman, Inc.'s Black Diamond pit, Ellensburg Cement Product facility, CSR's Everett Asphalt facility and the 410 Quarry in Enumclaw. Every attempt was made to sample equipment very similar to that being proposed for the North Bend Mine. The asphalt and concrete plants, front-end loaders, crushers and screens that were sampled are either identical or very similar to those being proposed (personal conversation Rod Shearer, Cadman Inc.). The D9 bulldozer sampled was older and noisier than the one that will be used at the North Bend Mine, but newer models were unavailable for sampling (personal conversation Darran Venters NC Machinery).

The noise signatures thus obtained form part of the input for a comprehensive noise prediction program known as the Environmental Noise Model (ENM). Other required inputs included detailed topographical information digitized from USGS topographical maps and project site maps, locations of the nearest residential properties and meteorological data. The noise modeling assumed a general plant layout as proposed by Cadman, with the following details:

- The asphalt plant is orientated with its exhaust fan facing south.
- Truck speed is limited to 10 mph onsite and 30 mph on 146th and Edgewick Road.
- Trucks will not have to backup while maneuvering onsite.
- The onsite roads are paved.

The noise impacts of this project's truck traffic were determined by using the Federal Highways Administration (FHWA) Traffic Noise Model (TNM version 1.1). This recently released model is the new standard for traffic noise analysis. It can account for the effects of topography, vegetation, roadway grade and low vehicle speeds. TNM is better suited for modeling traffic than ENM but does not allow the input of varying wind speeds, wind directions or atmospheric inversion parameters, as does ENM. This noise study used ENM to model the project's on-site stationary and mobile machinery (trucks, front-end loaders, bulldozers) under both typical, high wind and inversion meteorological conditions and then applied the difference between the three scenarios (due solely to meteorological conditions) to a TNM model of on-site and offsite traffic.

1.3 AGENCY COORDINATION AND INVOLVEMENT

This analysis draws upon a wide range of sources for data including federal, state and local government agencies, Cadman, Inc., equipment manufacturers, published studies of similar projects and local residents. This work was performed with assistance and coordination with the U.S. Environmental Protection Agency (EPA), King County Department of Health, the Bonneville Power Administration and the National Oceanographic and Atmospheric Agency (NOAA). Staff at the Bonneville Power Administration NOAA researched the availability of long-term rainfall data for the eastern North Bend area (and confirmed that it is not available). Staff at The Weather Center in North Bend provided insights into local weather conditions. Operators of concrete and asphalt facilities, and gravel and quarry operations in Ellensburg, Everett, Black Diamond, and Enumclaw provided assistance in obtaining noise signatures of machinery.

1.4 DEFINITION OF NOISE AND HOW IT IS MEASURED

Noise is defined as excessive or undesired sound. Human sensitivity to sound depends on its intensity, frequency composition and duration. Noise is measured on a scale whose units are termed decibels (dB). In order to represent the wide range of sounds audible to the human ear, this scale is logarithmic. With this scale an increase of 10 dB is perceived as a doubling of apparent loudness and an increase of 3 to 5 dB is noticeable under typical listening conditions. The greater sensitivity of the human ear to certain frequencies is approximated by skewing (or weighing) the decibel scale toward those frequencies. The weighted decibel scale which best approximates the response of the human ear is known as the A- weighted scale (dBA). Sound levels from a number of sources combine logarithmically. A project noise level of 50 dBA at a location (receiver) with and existing background noise level of 50 dBA results in a cumulative noise level of 53 dBA. This represents a project impact increase of 3 dBA.

The equivalent sound level (Leq) is a metric that is widely used for analysis purposes. The equivalent sound level is the level of a constant sound having the same sound energy at the fluctuating levels measured over a period of time. Minimum and maximum noise levels represent the range of the existing noise environment. The maximum noise levels are due to single events, which may or may not be typical of the monitoring site. The magnitudes of typical noises are shown in Table 1.

TABLE 1 A-WEIGHTED SOUND LEVELS AND HUMAN RESPONSE

Sound Source	dBA	Range of Human Response
Aircraft carrier operation	140	
Jet takeoff (200 ft away)	120	Painfully loud
Riveting machine	110	Maximum vocal effort
Shout (0.5 foot away)	100	
Heavy truck (50 ft. away)	90	
Busy street	80	Hearing damage with continuous exposure
Freeway traffic (50 ft. away)	70	Telephone use difficult
Air conditioning unit (20 ft)	60	
Light auto traffic	50	Quiet
Bedroom, library	40	
Soft whisper	30	Very quiet
Broadcasting studio	20	
Indefinable Source	10	Just audible
Indefinable Source	0	Threshold of hearing

Source: U.S. Council on Environmental Quality

Noise levels are affected by distance and physical buffers. Noise levels decrease as the distance from the source increases. As the distance from a point source, such as a rock crusher doubles the noise levels will decrease by 6 dBA. Noise reduction (attenuation) is greater over soft or rough ground compared to hard smooth surfaces such as concrete, asphalt or water. Dense trees can reduce noise levels if their trunks and branches completely block the view between source and receptor and/or their roots loosen the soil. A dense and deep (100 meters) buffer of evergreen vegetation can reduce noise by a maximum of 10 dBA.

1.5 REGULATION OF NOISE

Introduction

This project is subject to two types of noise regulations, each requiring a different type of analysis. The noise emitted by the project and calculated at its property lines must be compared to State and local regulations. In addition, Federal guidelines characterize the effects of a project's increase in noise levels by defined increases as "no impacts", "significant" or "serious". The first type of regulation looks at the maximum permissible noise level from only the project—existing background sound is not included. The second, requires knowing the background environment, adding the project's noise impacts and then comparing the total to Federal guidelines.

1.5.1 Federal Guidelines

EPA in Region 10 (Pacific Northwest) has developed draft guidelines indicating that an increase of less than 5 dBA is insignificant (causing few complaints), 5 to 10 dBA is significant (causing more complaints), and a increase over 10 dBA is a serious impact (leading to many more complaints). Mitigation is usually not required for impacts of less than 5 dBA. The EPA guidelines are not standards and do not have the force of law (personal conversation Curt Horner K.C. Dept. of Health), but do serve as useful indicators for potential noise impacts of projects undergoing SEPA review.

1.5.2 State and Local Regulations

The Washington State Department of Ecology (Ecology) has developed maximum permissible noise levels that a noise source may cause at the property lines of others. The permitted levels vary depending upon the land uses of the noise source and the receiving property. King County has developed noise regulations very similar to those of Ecology. The County's noise standards are shown in Table 2. The standards applicable to the Proposal are shown in bold. The maximum permissible levels are the limits a project can generate at its boundary with other land uses-- they are not the total of a project and background sound levels. In general, the closest residential properties are to the north of the Lower Site and are rural zones, the WoodRiver development is a residential zone, and Seattle Truck Town East and the other businesses along Edgewick Road (468th) are located in a commercial zone. The Lower Site lease area is bordered on the west by commercial forestry land (owned by the Weyerhaeuser Real Estate Company), on the east by publicly owned forest land, on the south by the right-of-way for I-90 and on the north by SE 144th Street, considered a commercial use. On the north side of SE 144th are residential lots with rural/residential zoning.

TABLE 2
KING COUNTY MAXIMUM PERMISSIBLE SOUND LEVELS (in dBA)

Land Use of Source:	Land Use of Receiving Property			
	Rural	**Residential**	**Commercial**	**Industrial**
Rural	49	52	55	57
Residential	52	55	57	60
Commercial	55	57	60	65
Industrial	**57**	60	**65**	70

Notes: Standards applicable to the proposed project are shown in bold.
Between the hours of 10 p.m. and 7 a.m. on weekdays and 10 p.m. and 9 a.m. during weekends, the maximum limits for rural and residential receivers are to be reduced by 10 dBA within residential receivers. For noises of short duration these limits can be exceeded by a maximum of 5 dBA for 15 minutes/hour, 10 dBA for 5 minutes/hour or 15 dBA for 1.5 minutes/hour.

In King County the noise from construction activities is exempt from the noise standards during daylight hours (7 a.m. to 10 p.m. weekdays and 9 a.m. to 10 p.m. weekends) for receivers located in rural and residential districts. Some types of noise are fully exempt from the Maximum Permissible Noise Level standards such as noises from construction activities (when they impact commercial zones) and safety equipment, for example backup alarms or sirens (King County Ordinance 12.94.010.B.3 and 12.94.010.2).

Motor vehicle traffic traveling on public roads is exempt from the noise regulations summarized in Table 2; however, the project's onsite traffic is not exempt under King County jurisdiction. Ecology has motor vehicle performance standards setting forth the maximum noise level from individual vehicles (and not applicable to general traffic noise) measured under specific testing criteria. These performance standards are applicable to vehicles operating on private roads such as the gravel mine access road.

It is assumed for the purposes of this study that the "Rural" zoning currently in place in the properties adjoining the project site to the north will be applicable into the future.

2.0 AFFECTED ENVIRONMENT

Background noise levels in the site vicinity were monitored to assess existing conditions. Measurements of 24 hours duration were taken at eight locations (Site 1 through Site 8) most likely to be affected by project-generated noise. Measurements were made on two consecutive days, with one site monitored on both days to serve as a point of comparison. Winds were generally southerly and light. There were periods of light rain during the two days of monitoring. A short-term measurement of local traffic was taken at Olallie State Park. Additional short-term noise measurements were taken during windy periods to determine the effect that winds have on background noise levels. Winds of 15 to 20 mph appear to add 7 to 9 dBA to background dBA_{LEQ} noise levels.

The North Bend area adjacent to the project site is currently subject to noise from a variety of sources with freeway traffic noises being predominant. Noise from the long westbound descent of I-90 into North Bend was noticeable at most of the measurement sites. Local truck and passenger car traffic was noticeable at Sites 2 (WoodRiver) and 4 (potential school site). The measurement locations for this analysis are shown in Figure 1 and described in Table 3. The noise level measurements are summarized in Table 4.

TABLE 3 24-HOUR NOISE MONITORING SITES

Site	Starting Time & Date	Location
Site 1	1:00 p.m. 3-17-99	Adjacent to SW corner of Lu residence
Site 2	1:00 p.m. 3-17-99	Adjacent to SE corner of WoodRiver
Site 3	1:00 p.m. 3-17-99	Located on east property line of 14110 475th
Site 4	1.00 p.m. 3-17-99	Located on potential new school site at Lake Dorothy Road
Site 5	2:45 p.m. 3-19-99	Located at 49211 SE Middle Fork Road
Site 6	2:45 p.m. 3-19-99	(Identical to Site 1) Adjacent to SW corner of Lu residence
Site 7	2:45 p.m. 3-19-99	Located on 47230 144th
Site 8	2:45 p.m. 3-19-99	Located at the NE property line of the Edgewick Inn
Site 9	11:00 a.m. 12-14-99	Short-term traffic noise at Olallie State Park

Details of site locations:
Sites 1 and 6 – 17 feet south of SW corner S18 T23N R93 Site 2 – 95 feet north of SE Middle Fork Road
Site 3 – Approx. 230 feet east of south end of 475th Site 4 – Located 60 feet north of and 270' east of SE Middle Fork Road
Site 5 – Located approximately 20 feet south of and 500 feet east of Middle Fork Road in the 49200 block, Site 7 – Located 60 feet north of 144th and 30 feet west of driveway of 47230, Site 8 – Located on east property line of the Edgewick Inn and 45 feet south of 146th
Site 9 – Located in Olallie State Park 60 feet north of SW Grouse Ridge

TABLE 4 MEASURED NOISE LEVELS (in dBA)

Monitoring Location	Minimum	Maximum	Leq 24-Hr	Day Leq	Night Leq	Highest 1-Hr Leq	Level day/night
Site 1	30.8	76.3	48.5	49.5	46.9	55.3	55.5
Site 2	36.0	71.0	51.0	53.0	48.7	55.8	55.0
Site 3	31.8	73.0	44.6	45.4	43.5	52.1	48.6
Site 4	38.3	88.2	51.5	52.9	49.8	57.2	58,3
Site 5	36.4	78.6	45.8	48.6	41.5	52.8	50.9
Site 6	28.4	70.4	50.0	51.4	47.6	55.6	54.6
Site 7	32.4	67.5	50.2	51.6	48.1	55.9	56.3
Site 8	49.2	79.2	57.6	57.6	57.6	60.7	64.5
Site 9	44.0	105.1	NA	NA	NA	55.6	NA

3.0 ENVIRONMENTAL IMPACTS

INTRODUCTION

The noise impacts of the North Bend Gravel Mine were analyzed using a combination of on-site measurements of operating equipment and computer simulations. The noise measurements are of the same models of equipment planned for this project. A summary of the noise sources (including locations) for each alternative is given on Table 5. The noise data for this equipment are summarized in Table 6. The noise measurements are in equivalent level A-weighted decibels (dBA_{LEQ}).

TABLE 5 NOISE SOURCES AND THEIR LOCATIONS

	Phase	D6 Dozer	D9 Dozer	992 Loader	988 Loader	980 Loader	Primary Crusher	Scalping Screens	Belly Scrapper	Service Truck	Process Plant	Concrete Plant	Asphalt Plant	Conveyor Belt	Cat 769 Haul Trucks	Highway Gravel Haul Trucks	Asphalt & Concrete Haul Trucks
Lower Site																	
Alt. 2 (Proposal)	1		X	X					X	X							
	2		X	X	X		X	X	X	X						X	
	3		X	X	X		X	X	X	X						X	
	4				X		X	X	X	X				X		X	
	5				X	X				X	X			X		X	
	6				X	X				X	X			X		X	
	7				X	X				X	X	X	X	X		X	X
	8				X	X				X	X	X	X	X		X	X
	9	X				X				X	X	X	X	X		X	X
	10	No equipment															
Alt. 3 (Lower and Upper Sites)	1		X	X					X								
	2		X	X	X		X	X	X							X	
	3		X	X	X		X	X	X	X						X	
	4				X		X	X	X	X						X	
	5				X	X				X							
	6					X				X		X	X			X	
	7					X				X		X	X			X	X
	8					X				X		X	X			X	X
	9	X				X				X		X	X			X	X
	10	No equipment															
Alt. 4 (Upper Site Only)	All Phases	No equipment															
Upper Site																	
Alt. 2 (Proposal)	1																
	2																
	3																
	4		X	X						X							
	5		X	X			X	X		X				X	X		
	6		X	X			X	X		X				X	X		
	7		X	X			X	X		X				X	X		
	8		X	X			X	X		X				X	X		
	9		X	X			X	X		X				X	X		
	10	No Equip.															
Alt. 3 (Lower and Upper Sites)	1																
	2																
	3																
	4		X	X													
	5		X	X		X	X	X	X							X	
	6	X	X	X		X	X	X	X	X						X	
	7	X	X	X		X	X	X	X	X						X	
	8	X	X	X		X	X	X	X	X						X	
	9	X	X	X		X	X	X	X	X						X	
	10	No equipment															
Alt. 4 (Upper Site Only)	All Phases	X	X	X	X		X	X	X	X					X	X	

TABLE 6
PROJECT-GENERATED NOISE SOURCES
NOISE LEVELS 50 FEET FROM SOURCE

Equipment	dBA_{LEQ}
Bulldozer (Cat D6)[1]	72
Bulldozer (Cat D9)[5]	85
Front-end loader (Cat 988)[2]	75
Primary crusher[2]	84
Processing facility[2]	79
Wash facility [3]	82
Conveyor belt transfer point[52]	73
Concrete facility[3]	82
Asphalt facility- outside plant[4]	53-78
Asphalt burner- inside plant[4]	92
Loaded gravel truck traveling at 25 mph[2]	65
Loaded gravel truck Traveling at 55 mph[2]	67
Empty gravel truck traveling at 25 mph[2]	55

Note: The energy levels shown are dBA_{LEQ} derived from 1/3 octave band measurements of the equipment

Sources:
[1] Cadman, Inc., North Bend, WA-calculated from a D4
[2] Cadman, Inc., Black Diamond Operation, Black Diamond, WA
[3] Ellensburg Concrete Products, Ellensburg, WA
[4] CSR, Inc., Everett Asphalt Facility, WA - Noise levels vary with direction-Plant uses a Hauk Echostar 125 burner
[5] D9H at the 410 Quarry, Enumclaw, WA

3.1 CONSTRUCTION IMPACTS

The construction phase of the Proposal consists of the following:

- Removing the overburden from the Lower Site in order to build an earthen berm on the north and south sides of the processing area
- Excavating a freshwater storage pond
- Using the overburden and excavated material to build an earthen berm on the north and south sides of the processing area
- Disposing of unusable woody material (slash)
- Clearing a route for the aggregate conveyor transversing the western slope of Grouse Ridge
- Building the aggregate processing, concrete plant on the Upper Site
- Building and paving access roads and plant aprons

Construction noise impacts would be the noise generated by earth-moving equipment such as belly-scrapers, bulldozers and front-end loaders. Construction noise impacts are exempt from King County Maximum Permissible Noise Levels, but are not exempt from SEPA review.

3.1.1 Alternative 1–No Action

Timber harvesting under Alternative 1 could cause noise-related impacts of fairly short duration, but it is not possible to quantify such impacts without a specific harvesting proposal.

3.1.2

3.1.2 Alternative 2 – Proposal

Construction at the Lower Site will consist of deepening the existing gravel pit, excavating a fresh water storage pond; building access roads, building the asphalt and concrete batch plants and removing the overburden in order to build the north and south berms. Construction noise comes from heavy equipment such as bulldozers, front-end loaders and belly-scrappers. It was assumed that three D-9 bulldozers would be at work simultaneously, one excavating the pond, one removing overburden and one clearing the conveyor belt road. A Cat 980 front-end loader would move material from the pond to the berm site. A belly scrapper would also remove overburden and carry it to the berm area. Construction noise levels impacts were modeled using the ENM model with project-generated levels ranging from less than 1 dBA at some of the residences south of I-90 (S.E. 153rd) to 15-30 dBA along SE 144th Street. Construction noise impacts upon rural or residential property are exempt from the King County Maximum Permissible Noise Levels (57 dBA day/47 dBA night) during daytime hours. No construction would occur at night (10 PM to 7 AM). The neighborhood's cumulative noise levels during mine construction would be unchanged from current conditions.

Table 7 summarizes the expected noise levels from construction activities at the Lower Site for Alternative 2.

TABLE 7
ALTERNATIVE 2 LOWER SITE CONSTRUCTION NOISE LEVELS (IN dBA Leq)
TYPICAL METEOROLOGICAL CONDITIONS

Receiver	Background Noise Levels Day/Night	Mine Noise Levels Day/Night	K.C. Noise Code Day/Night	Exceedance of KC Noise Code Day/Night?
1-Lu Residence	50/47	18/18	57/47	No/No
2-Residence at 14118 475th	57/53	16/16	57/47	No/No
3-Residence at 47230 SE 144th	46/44	15/15	57/47	No/No
4-Residence A	49/42	6/6	57/47	No/No
5-Residence B	49/42	6/6	57/47	No/No
6-Residence C	49/42	1/1	57/47	No/No
7-Residence D	49/42	1/1	57/47	No/No
8-Residence E	49/42	2/2	57/47	No/No
9-Residence F	49/42	1/1	57/47	No/No
10-Residence G	49/42	1/1	57/47	No/No
11-NW corner	50/47	18/18	57/47	No/No
12-NW-1	50/47	20/20	57/47	No/No
13-NW-2	50/47	22/22	57/47	No/No
14-NW-3	50/47	25/25	57/47	No/No
15-NE corner	50/47	31/31	57/47	No/No
16-SLM 1 & 6	51/48	20/20	57/47	No/No

17-SLM 2	53/49	6/6	57/47	No/No
18-SLM 3	45/44	16/16	57/47	No/No
19-SLM 4	53/50	4/4	57/47	No/No
20-SLM 5	49/42	0/0	57/47	No/No
21-SLM 7	52/48	18/18	57/47	No/No
22-SLM 8	58/58	16/16	65/65	No/No
23-Lutheran Camp	49/46	0/0	57/47	No/No
24-Washington State Patrol Fire Training Academy	53/50	0/0	57/47	No/No
25-Mine Creek Campground	49/46	0/0	57/47	No/No
26-Lu Auxiliary Residence	50/47	25/25	57/47	No/No

Alternative 2 – Lower Site Option

Construction noise levels will be nearly identical to those of Alternative 2 Proposal except that the smaller footprint will require less time to excavate.

3.1.3 Alternative 3 – Lower and Upper Sites (Exit 34 and Exit 38)

Alternative 3 will have construction noise levels nearly identical to those of Alternate 2 Proposal.

Alternative 3 – Lower Site Option

Construction noise levels will be nearly identical to those of Alternative 3 Lower and Upper Sites except that the smaller footprint will require less time to excavate.

3.1.4 Alternative 4 – Upper Site Only (Exit 38)

Construction activities consist of preparing access roads and a processing plant area on the Upper Site. The noise impacts from these activities will be minor. The removal of overburden and woody debris will be a part of ongoing mining operations on the Upper Site

3.2 OPERATION IMPACTS

3.2.1 Modeling of On-Site Equipment

Computer modeling of project-generated noise levels was used to simulate conditions during Phase 8 (peak production) of the proposed project. Phase 8 was selected because all the proposed noise sources would be operational during this phase. Three meteorological conditions were modeled: (1) a "typical" condition of no atmospheric stagnation and a very light breeze of 2.2 mph (personal conversation Renzo Tonin, RTA Technology Ltd), (2) an inversion condition of a stagnant atmospheric with a moderate breeze of 6.7 mph, and (3) a "high wind" scenario of 22 mph winds from the east-southeast. The topography used in the ENM model was digitized from project sites plans and USGS topographical maps.

Typical Conditions Model

The stationary mining equipment (crusher, conveyor belt, screens, etc.) and mobile mining equipment (front-end loaders, bulldozers) were modeled with the Environmental Noise Model, which is capable of both point source and line source noise calculations. The onsite truck traffic was modeled using TNM, and the trucks' noise impacts were added to the noise from the mining equipment to account for all of the proposed project's noise impacts from onsite sources.

Inversion and High Wind Models

The effects of inversion meteorology and high wind conditions were analyzed by using ENM to model both of these meteorological conditions and then comparing the results to the ENM model results for typical conditions. The difference between the two models (which differ only in wind speed, wind direction and atmospheric temperature gradients) is due solely to meteorology. The numerical difference between the inversion or high wind conditions and typical conditions was then added to the typical conditions model (described above) to create the inversion and high wind results. Neither the inversion nor high wind scenarios is likely to be the basis by which this project would be deemed to be in compliance with the King County Noise Ordinance, but their examination is necessary to meet the SEPA requirements for worst-case analysis.

Some of the proposed project's activities, such as trucking and the startup of the asphalt plant would occur during the time period defined as "night" under the King County Noise Ordinance. As a worst-case assumption, this analysis assumes that all the project's equipment (except for the conveyor belt, which would start up only after the Upper Site begins at 7 a.m.) could be operating before 7 a.m. and generating nighttime noise levels (from 5 a.m. to 7 a.m.) identical to its daytime levels. Table 6 presents the results of the modeling.

In the North Bend area, winds of 20 mph and greater are predominately from the east-southeast and occur approximately 145 days a year (personal conversation Eric Molstad). These high winds would tend to bend sounds from the project toward the northwest. Table 8 summarizes the modeling for all meteorological scenarios.

Some of the project's activities, such as trucking and the startup of the asphalt plant, occur during the time period defined as "night" under the K.C. Noise Ordinance. As a result, due to the operating hours of the project and the definition of nighttime (10:00 p.m. to 7:00 a.m. on weekdays and 10:00 p.m. to 9:00 a.m. on weekends/holidays), Alternate 2 will have nighttime noise levels (during the 5 am to 7 am period) that are identical to its daytime levels. Any exceedances of the K.C. Noise Ordinance are shown in **bold**.

TABLE 8
PEAK PRODUCTION NOISE LEVELS (in dBA Leq)
HIGH WIND, TYPICAL INVERSION AND INVERSION METEOROLOGICAL CONDITIONS
ALL ONSITE EQUIPMENT AND TRUCKS

Receiver	Background Noise Levels Day/Night	Gravel Operation Noise Alternative 2 Day/Night			Gravel Operation Noise Alternative 3 Day/Night			Gravel Operation Noise Alternative 4 Day/Night			Noise Standard Day/Night	
		High Winds	Typical	Inversion	High Winds	Typical	Inversion	High Winds	Typical	Inversion		
1-Lu Residence	50/47	38/38	28/28	40/40	26/25	23/21	37/35	0/0	0/0	0/0	57	47
2-Residence at 14118 475th	45/44	46/46	29/29	43/43	38/36	25/23	39/37	0/0	0/0	0/0	57	47
3-Residence at 47230 SE 144th	46/44	52/**52**	33/33	45/45	46/44	29/27	41/39	0/0	0/0	0/0	57	47
4-Residence A	No data	55/**55**	41/41	43/43	49/47	36/35	38/36	0/0	0/0	0/0	57	47
5-Residence B	No data	54/**54**	40/40	41/41	44/42	36/34	36/35	0/0	0/0	0/0	57	47
6-Residence C	No data	45/45	42/42	42/42	36/34	38/36	38/36	0/0	0/0	0/0	57	47
7-Residence D	No data	43/43	42/42	42/42	34/32	38/36	38/36	0/0	0/0	0/0	57	47
8-Residence E	No data	42/42	42/42	42/42	35/33	38/36	38/36	0/0	0/0	0/0	57	47
9-Residence F	No data	42/42	42/42	42/42	34/32	37/35	38/36	0/0	0/0	0/0	57	47
10-Residence G	No data	42/42	42/42	42/42	34/32	37/35	38/36	0/0	0/0	0/0	57	47
11-NW corner	50/47	56/**56**	41/41	49/**49**	50/**48**	37/35	44/42	0/0	0/0	0/0	57	47
12-NW-1	50/47	52/**52**	38/38	46/46	46/44	33/31	40/39	0/0	0/0	0/0	57	47
13-NW-2	50/47	50/**50**	36/36	45/45	42/41	31/29	40/38	0/0	0/0	0/0	57	47
14-NW-3	50/47	47/47	35/35	44/44	37/36	31/29	39/37	0/0	0/0	0/0	57	47
15-NE corner	50/47	43/43	43/43	52/**52**	27/25	38/36	47/45	0/0	0/0	0/0	57	47
16-Sites 1 and 6	50/47	53/**53**	42/42	51/**51**	39/37	37/35	44/43	0/0	0/0	0/0	57	47
17-Site 2	53/49	**61/61**	38/38	51/**51**	54/**52**	34/32	45/43	0/0	0/0	0/0	57	47
18-Site 3	45/44	41/41	28/28	42/42	34/32	23/21	39/37	0/0	0/0	0/0	57	47
19-Site 4	53/50	**63/63**	37/37	51/**51**	56/**54**	33/31	45/43	0/0	0/0	0/0	57	47
20-Site 5	49/42	0/0	0/0	0/0	0/0	0/0	7/7	0/0	0/0	7/7	57	47
21-Site 7	52/48	53/53	37/37	45/45	46/44	33/31	40/38	0/0	0/0	0/0	57	47
22-Site 8	58/58	65/65	47/47	54/54	59/57	43/41	49/47	0/0	0/0	0/0	65	65
23-Lutheran Camp	49/46	0/0	0/0	11/11	0/0	0/0	0/0	0/0	0/0	11/11	57	47
24- Washington State Patrol Fire Training Academy	53/50	19/0	12/0	21/0	27/0	26/0	30/4	26/0	26/0	30/0	57	47
25-Mine Creek Campground	49/46	0/0	0/0	4/4	0/0	0/0	0/0	0/0	0/0	0/0	57	47
26-Lu Auxiliary Res.	50/47	32/32	28/28	37/37	20/10	24/22	32/31	0/0	0/0	0/0	57	47
Number of Exceedances of K.C. Standards		2/9	0/0	0/5	0/3	0/0	0/0	0/0	0/0	0/0		

Notes:

Typical meteorology is defined as winds of 1 meters/second (4.4 mph) from the south (180^o) in a neutral atmosphere (-1^o/100 meters)
Inversion meteorology is defined as winds of 3 meters/second (6.7 mph) from the south in a stagnant atmosphere (4^o/ 100 meters)
The sites with no monitored background data (Residences A-G) will be assumed to have a background level daytime/nighttime LEQ of at least 50/47 dBA due to their proximity to I-90.
"High Wind" meteorological is defined as winds of 10 meters/second (22 mph) from the east/southeast (113º) in a neutral atmosphere (-1º/100 meters)

TABLE 9 NOISE LEVELS AND IMPACTS OF OFFSITE TRUCK TRAFFIC (in dBA Leq) ALTERNATIVES 2, 3, AND 4 PEAK PRODUCTION (2025)

Receiver	Year 2000 Background Noise Levels Day/Night LEQs	Year 2025 Non Project Traffic	Offsite Truck Traffic Noise Alternative 2 (Impacts)	Offsite Truck Noise Alternative 3 (Impacts)	Offsite Truck Noise Alternative 4 (Impacts)
16-Site 1 and 6	51/48	43	39 (+1)	36 (+1)	39 (+1)
17-Site 2	53/49	44	42 (+2)	38 (+1)	42 (+2)
18-Site 3	45/44	41	39 (+2)	35 (+1)	39 (+2)
19-Site 4	53/50	46	43 (+2)	40 (+1)	43 (+2)
20-Site 5	49/42	No Data	No Project Traffic	No Project Traffic	No Project Traffic
21-Site 7	52/48	49	44 (+1)	41 (+1)	44 (+1)
22-Site 8	58/58	**71**	**74 (+4)**	69 (+2)	50 (+0)
24-Washington State Patrol Fire Training Academy	49/42	No Data	Minimal Project traffic	**61 (+11)**	**61(+11)**
26-Site 9 Olallie St. Park	49/42	No Data	Minimal Project traffic	**63 (+13)**	**63 (+13)**

Notes:

The sites with no data on 2025 traffic volumes are rural roads with low usage. It is assumed that 2025 background noise levels will be very similar to current measured levels (approximately 50 dBA) on those roads. Sites where truck noise could be audible over projected year 2025 background sounds are shown in bold.
"Impacts" are the noises increase due to the project and are the differences between the 2025 Background and the project's truck noise minus the 2025 background traffic noise.

3.2.2 Summary of the Project's Operational Impacts

Alternative 1–No Action

Timber harvesting under Alternative 1 could cause noise-related impacts, but it is not possible to quantify such impacts without specific harvest proposals.

Alternative 2–Proposal: Lower and Upper Sites Mining (Including Limited Lower Site Mining)

Noise from Onsite Activities

The project's noise levels would exceed the standards set out in the King County Noise Code during the High Wind and Inversion scenarios. Under the High Wind scenario exceedances would occur at two locations during the day and nine locations during the 5AM-7AM (nighttime) period. Under the Inversion scenario there would be five nighttime exceedances.

Noise from Offsite Truck Traffic

Residential and commercial uses located outside the proposed project's boundaries would be closer to, and more affected by, project traffic using offsite (public) roads than when that traffic is using the onsite roads. The largest increase in noise from Alternative 2 would be 4 dBA (compared to the 2025 background) at Site 8 (Edgewick Inn). This increase would be defined by EPA as "no impact." Noise levels inside the Edgewick Inn would not be noticeably different due to the project unless windows were open in the rooms facing SE 146th Street, when a slight increase could be apparent. Due to the use of I-90 by truck traffic approaching and leaving Exit 34, there would be small increases (of 4 dBA or less) at the residences located on the south side of I-90 along SE 153rd Street. These increased noise levels would generally be inaudible during the day but could be audible during quiet periods, such as at night.

Alternative 3–Lower and Upper Sites (Including Limited Lower Site Mining)

Noise from Onsite Activities

Under the High Wind scenario the project's noise levels will exceed the standards set out in the King County Noise Ordinance's nighttime standards at three locations- near WoodRiver, the proposed school site and the NW corner of the Lower Lease area.

Noise from Offsite Truck Traffic

Alternative 3 would cause an increase (compared to 2025 background) of approximately 2 dBA at the Edgewick Inn (Site 8) and a 13 dBA increase at Site 9 (Olallie State Park). The increase at Exit 38 would be defined by EPA as a "serious" increase. Alternative 3 would also cause a noise increase of 11 dBA (defined as "serious") at the Fire Training Academy, adjacent to the dormitories and classroom buildings. This increase could be slightly audible when the windows and doors are closed, but would be a distraction if the windows were open. Due to the use of I-90 by truck traffic approaching and leaving Exit 38, there would be small increases (of 4 dBA or less) at the residences located on the south side of I-90 along SE 153rd Street. These increased noise levels would generally be inaudible during the day but could be audible during quiet periods, such as at night.

Alternative 4–Upper Site Mining (Exit 38)

Noise from Onsite Activities

Under Alternative 4, the project's noise levels at any receiver would not exceed the standards set out in the King County Noise Code, including the more stringent nighttime (10 p.m. to 7 a.m.) standard of 47 under either the typical, inversion, or high wind scenarios.

Noise from Offsite Truck Traffic

Alternative 4 would cause an increase in noise of approximately 13 dBA at Site 9 (Olallie State Park). This increase would be defined by EPA as a "serious" impact. Alternative 4 would also cause a noise increase of 11 dBA (defined as "serious") at the Fire Training Academy, adjacent to the dormitories and classroom buildings. This increase could be slightly audible when the

windows and doors are closed, but would be a distraction if the windows were open. Due to the use of I-90 by truck traffic approaching and leaving Exit 38, there would be small increases (of 4 dBA or less) at the residences located on the south side of I-90 along SE 153rd Street. These would generally be inaudible during the day but could be audible during quiet periods, such as at night.

3.2.3 Impacts of Noise on Wildlife

Research conducted to examine the effects of noise on animals has focused primarily on investigations of high noise levels (above 100 dBA) on laboratory animals, studies of ambient noise measurements in barns or kennels, or the effects of aircraft noise. These studies generally indicate that if adverse effects are present, the effects do not occur until noise levels approach 95 to 100 dBA. Most animal species appear to adapt to ambient noise as part of their environment. Loud sudden noises would startle mammals and birds into sudden movement or flight. Animals are generally tolerant of regular, steady noise such as would be produced by the steady operation of mining machinery. Research by the U.S. Air Force indicates that domestic sheep are capable of perceiving noises in the 7 to 18 decibel range over the 100 to 7,000 hertz (Hz) frequency range. These levels are similar to what the project would cause along the northern border of the Lower Site. The data for sheep could be assumed to be true for deer and elk also. The fact that deer or elk could hear the project does not necessarily mean those species would be disturbed or adversely impacted.

The Washington State Department of Fish and Wildlife has established guidelines to protect certain animal species from noise disturbance. These guidelines establish buffer zones (generally ¼ or ½ mile) around the nesting areas of certain threatened or endangered bird species (such as the spotted owl and marbled murrelet). There are no listed species or nesting sites within ½ mile of the project's lease area. Some of the closest habitat suitable for the marbled murrelet may be along I-90 east of milepost 38 adjacent to SE Grouse Ridge Road and Olallie State Park.

3.3 CUMULATIVE IMPACTS

Cumulative noise impacts are the sum of the project impacts at a future date (2025 in this analysis) and future background noise levels. The primary cause of higher background noise levels in the future would be increased vehicle traffic. This noise analysis uses year 2025 traffic volumes for Alternates 2 and 3 at the 468th/146th intersection (Exit 34) and along I-90 between Exits 32 and 38. Projected increases in cumulative noise levels are compared to EPA Guidance to determine impacts. Table 10 summarizes the cumulative daytime impacts of the project under typical meteorological conditions.

TABLE 10
CUMULATIVE NOISE IMPACTS
PEAK PRODUCTION IN 2025
(in dBA Leq)

Receiver	Total Project Noise (all onsite equip. & trucks plus offsite trucks) Alternative 2	Total Project Noise (all onsite equip. & trucks plus offsite trucks) Alternative 3	Total Project Noise (all onsite equip. & trucks plus offsite trucks) Alternative 4	Increase in Noise due to Alternative 2. Compared to 2025 Background	Increase in Noise due to Alternative 3 Compared to 2025 Background	Increase in Noise due to Alternative 4 Compared to 2025 Background
1-Lu Residence	39	35	39	0	0	0
2-Residence at 14118 475th	39	37	39	0	0	0
3-Residence at 47230 SE 144th	42	39	42	2	0	2
4-Residence A	52	51	52	4	4	4
5-Residence B	52	52	52	4	4	4
6-Residence C	51	51	51	4	3	4
7-Residence D	51	51	51	4	4	4
8-Residence E	51	51	51	4	3	3
9-Residence F	51	51	51	4	3	3
10-Residence G	51	51	51	4	3	3
11-NW corner	40	43	51	0	1	4
12-NW-1	43	40	44	1	0	1
13-NW-2	41	38	41	1	0	1
14-NW-3	41	38	40	1	0	0
15-NE corner	47	45	39	2	1	0
16-Site 1 and 6	43	39	45	1	0	1
17-Site 2	44	40	43	0	0	0
18-Site 3	39	35	39	0	1	0
19-Site 4	44	40	50	0	0	0
20-Site 5	30	30	30	0	0	0
21-Site 7	45	42	39	3	0	1
22-Site 8	74	69	44	4	2	0
23- Washington State Patrol Fire Training Academy	35	61	61	0	12	12
24-Mine Creek Campground	30	30	30	0	0	0
25-Lu Aux. Residence	40	36	42	0	0	0
26-Site 9 Olallie St. Park	35	62	63	0	12	13

As shown in Table 10, cumulative noise levels would show a substantial increase at two locations: the Fire Training Academy and at Exit 38 (Olallie State Park) as a result of project truck traffic. These cumulative increases would be considered "serious" under the draft EPA noise guidelines. None of the other increases shown in Table 10 would be considered an impact.

The noise modeling analysis shows that, generally speaking, the noise levels of the proposed project would not exceed existing background noise levels (except for the two locations mentioned above and south of I-90 for Residences A-G). However, project construction and operations would likely be audible because the frequency spectrum of a mine's noise differs from the types of noise found in residential areas. In addition, noise from the project could be clearly audible during the periods of very low background noise (such as stoppages of traffic on I-90). Certain frequencies (such as backup alarms) would stand out over the background noise environment.

4.0 MITIGATION MEASURES

Under typical meteorological conditions no mitigation measures would be required for the operation of any of the onsite portions of the Project in order to meet the King County Noise Ordinance mitigation measures would be required to minimize impacts during high winds or inversions- primarily during the 5AM to 7 AM period.

Alternative 1–No Action

No noise-related mitigation measures would be required under Alternative 1. Noise from timber harvesting could be loud at times but would be of short duration (a few weeks at most).

Construction Activities for Alternatives 2, 3 and 4 (Including Limited Lower Site Mining)

The potential for noise impacts resulting from construction under each Action Alternative (2, 3, and 4) would be minimized by adhering to the King County Noise Ordinance regulations. Construction work would not occur between the nighttime hours of 10 p.m. and 7 a.m. on weekdays and 10 p.m. and 9 a.m. on weekends.

Operational Activities for Alternatives 2 and 3 (Including Limited Lower Site Mining)

The following specific mitigation measures are proposed for Alternatives 2 and 3.

- Minimize truck trips during the 5 AM to 7 AM period. (The modeling analysis conservatively assumes AM peak hour truck volumes could occur in the early morning period as a "worst-case" analysis.)
- The asphalt facility should be oriented so that truck entrances face east and west and the exhaust fan is on the south side of the building. The ENM modeling assumes this orientation.
- Truck speeds should be kept as low as possible. A speed limit of 10 mph should be maintained within the Lower Site. It may not be practical to re-designate the speed limit on the Olallie Park/SE Grouse Ridge Road. No aggregate hauling would occur on the weekends, the time of greatest park use.
- Maintain a 25 mph speed limit on SE 146th Street between 468th Avenue SE and the existing gate to the east, and maintain a smooth road surface to reduce tire noise and air-bourn vibration.
- Standard acoustic backup alarms should be replaced with background noise-sensitive alarms.
- Squeaks and squeals should be minimized by regular maintenance and lubrication of equipment.
- A noise monitoring program should be implemented to track any changes in overall noise levels starting with the construction phase. This program should will monitor the proposed project's noise impacts at the nearest residential properties on a regular basis. The sites most likely to experience noise increases from truck traffic (Olallie State Park, the Edgewick Inn and residences south of I-90) should receive a more intensive level of monitoring than less impacted sites.

Alternates 3 and 4–Upper Site Only (Exit 38)

The possibility of relocating the truck route further away from the classrooms and dormitories of the Fire Training Academy should be investigated for both Alternates 3 and 4. Any noise monitoring plan should include Olallie State Park and the residences south of I-90. No other mitigation measures would be required for Alternative 4.

5.0 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

The proposed project would cause no significant noise impacts, after mitigation measures are in place, from onsite activities at sensitive receptors adjacent to the Upper or Lower Site operations. There would be significant unavoidable adverse impacts under Alternatives 3 and 4 at Olallie State Park (Exit 38) due to increased noise levels with additional truck traffic. The noise impacts to the Fire Training Academy can be adequately mitigated below the level of significance if an alternate truck route is found which increases the distance between the Academy and the current road. Most of the increase in cumulative noise levels shown for Site 8 (Edgewick Inn) would be due to the increase in non-project traffic projected for 2025 at that location. The noise increase resulting from the proposed project operations at Site 8 would not be considered "significant."

6.0 REFERENCES

Personal conversation, Curt Horner, King County Department of Health, 1999.

Personal conversation, Eric Molstad, North Bend meteorologist, 1999.

Personal conversation, Rod Shearer, Cadman, Inc. June through September 1999.

Personal conversation, Renzo Tonin, ENM Developer, 1998.

7.0 Appendix to the Noise Technical Report

Contents:

Noise Monitoring Data

Machinery Noise Data

Environmental Noise Model Output

Traffic Noise Model Output

Calculation Spreadsheets

The information contained in this Appendix is on file with King County.